PATENT SPECIFICATION

DRAWINGS ATTACHED

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COMPLETE SPECIFICATION

Improvements in or relating to Pneumatic Tyres

We DUNLOP RUBBER COMPANY LIMITED, a British Company of 1, Albany Street, London, N.W.1. do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement: —

This invention relates to pneumatic tyres.

In the conventional pneumatic tyre, the carcass of the tyre is reinforced with a ply or plies of rubberised substantially inextensible cord material, the cords being either of nylon or rayon or of steel and being wrapped at each end of the carcass around a bead wire.

Aircraft tyres manufactured in the conventional manner, however, are now being fitted to aircraft, the gross weights of which and/or the landing speeds of which, are greater than those of earlier comparable types of aircraft to which tyres have previously been fitted. It is necessary, therefore, that the degree of braking required to halt these aircraft upon landing is greater than that required to halt the earlier type aircraft. In consequence of this heavier braking, a considerable amount of heat is generated in the brake drums which is conducted from the brake drums into the bead and lower sidewall regions of the tyres. Cases have been known in which the temperatures of tyres in these regions have been raised so as to exceed the melting point of the rayon and nylon cords used in the carcass plies. When the bead regions of a conventional tyre are subjected to such temperatures, the cords, whether or nylon, rayon or steel, become separated from the surrounding rubber, and the air pressure within the tyre causes the ends of the plies to unwrap themselves from the bead wires resulting in disintegration of the carcass.

It is the object of the present invention to provide a pneumatic tyre which will withstand high temperature conditions without carcass disintegration.

According to the invention a pneumatic tyre comprises a pair of coaxial bead wires in each bead region, one of said bead wires nesting radially within the other, and the opposed nesting surfaces of the bead wires being complementary, and a reinforcing ply secured in each bead region between the opposed nesting surfaces of the bead wires.

Preferably, the reinforcing ply is of rubberised steel wire cord construction.

Preferably also, the radially inner bead wire is formed from a solid steel wire of cross-sectional area approximately equal to that of a conventional bead wire. The radially inner bead wire extends around the tyre with its ends joined together in abutting relationship e.g. by welding. The radially inner bead wire may, however, be of a rubberised composite wire construction.

Preferably also, the opposed nesting surfaces of the bead wires are complementary frusto-conical surfaces which extend generally in an axial direction.

One embodiment of the invention will now be described, by way of example, with reference to the accompanying drawing which shows an axial cross-sectional view of the right-hand bead region of a pneumatic tyre according to the invention.

An pneumatic tyre 1 reinforced in the tread region with a layer of rubberised parallel steel cord material (not shown) comprises, in each bead region, a solid steel bead wire 2 and a composite coiled wire bead wire 3. The tyre also comprises, in the carcass, a single reinforcement ply 4 of parallel rubberised steel cord material which extends around the tyre from one bead region to the other with the cords disposed at 90° to the mid-circumferential plane of the tyre.

In each bead region the solid steel bead

[*Price 4s. 6d.*]

wire 2 is nested within the bead wire 3. The cross-sectional area of the solid steel bead wire is approximately equal to that of conventional bead wires used in tyres of the same size. The radially outer regions of the solid steel bead wire terminate in a frusto-conical surface 5 which extends generally in an axial direction at an angle of substantially 15° to the axis of rotation of the tyre, with the end of the surface of smaller diameter lying in the axially outermost position. The base 6 of the solid steel bead wire is of rounded form to facilitate the turning of the ply 4 now to be described.

The end of the ply 4 extending into the bead region extends down the inner sidewall region, axially inwardly of the bead wires, around the rounded base 6 of the solid steel bead wire and then continues across the frusto-conical surface 5 of the bead wire from one side of the surface to the other in an axially inward direction.

The composite wire bead wire 3 is of triangular cross-section and is formed from a single length of rubberised steel filamentary wire extending circumferentially around the tyre in a plurality of convolutions. The bead wire 3 tapers radially outwardly from a frusto-conical surface 7 which is shaped complementary to the frusto-conical surface 5 of the solid steel bead wire. The frusto-conical surface 7 lies in contact with the end portion of the carcass reinforcement ply 4 which extends across the solid steel bead wire so that the said ply end is securely held between the two bead wires.

The tyre is also provided in each bead region with a chafer reinforcement 8 which extends from the heel of the bead region radially outwardly into the lower sidewall region, the chafer reinforcement comprising a length of steel cord material formed into a plurality of convolutions extending circumferentially around the tyre as is described in our copending British Patent Application No. 28524/58, (Serial No 922,395).

In the manufacture of the tyre, the carcass is built in a substantially cylindrical condition upon a collapsible tyre building former. The carcass reinforcement ply 4 is positioned around the former, a pair of solid steel bead wires 2 located one at each end of the former and the ends of the ply turned over the bead wires. The composite coiled wire bead wires 3 are then moved axially over the solid steel bead wires, one at each end of the former, and pressed into engagement with the turned over ends of the carcass reinforcement layer so as to wedge each end of the ply between its associated bead wires. The tyre is completed in the usual manner by adding sidewall strips, the tread reinforcement and the tread rubber, and is inflated into a toroidal shape and then moulded within a tyre mould.

When a tyre of the type described above is subjected to high temperatures in the bead region due to heavy braking, heat from the brake drum is conducted through the tyre into the solid bead wire 2, and then through the end of the carcass reinforcement layer into the composite wire bead wire 3. The solid steel bead wire, because of its solid steel construction, is a better heat conductor than the composite wire bead wire and it is also disposed nearer to the source of heat that the composite wire bead wire. The coefficients of expansion of the solid steel bead wire and the wire of the composite wire bead wire are approximately equal and consequently the rate of expansion of the solid steel bead wire is greater than that of the composite wire bead wire so that, as the temperature in the bead region increases, the solid steel bead wire expands radially outwardly at a faster rate than does the composite wire bead wire and more firmly secures the end of the carcass reinforcement layer between the bead wires to prevent slippage of the said end.

In a modification of the embodiment described above, the solid steel bead wire 2 is replaced by a bead wire of composite wire construction. Although in this case, the radially inner bead wire is not, by virtue of its composite construction, a better heat conductor than the radially outer bead wire, the radially inner bead wire is nearer to the source of heat than the radially outer bead wire so that the temperature of the radially inner bead wire rises to a higher level than that of the radially outer bead wire when the brake is applied to the brake drum.

WHAT WE CLAIM IS:—

1. A pneumatic tyre comprising a pair of coaxial bead wires in each bead region, one of said bead wires nesting radially within the other and the opposed nesting surfaces of the bead wires being complementary, and a reinforcing ply secured in each bead region between the opposed nesting surfaces of the bead wires.

2. A pneumatic tyre according to claim 1 wherein the reinforcing ply is of rubberised steel wire cord construction.

3. A pneumatic tyre according to either of the preceding claims wherein the radially inner bead wire in each bead region is a solid steel wire.

4. A pneumatic tyre according to claim 3 wherein the ends of the radially inner bead wire are joined together in abutting relationship.

5. A pneumatic tyre according to either of claims 1 and 2 wherein the radially inner bead wire in each bead region is of rubberised wire construction.

6. A pneumatic tyre according to any of the preceding claims wherein the complementary shaped surfaces are frusto-conical and extend generally in an axial direction.

7. A pneumatic tyre according to claim 6 wherein the opposed surfaces are inclined at an angle of substantially 15° to the axis of rotation of the tyre.

8. A pneumatic tyre according to any of the preceding claims provided in each bead region with a chafer reinforcement.

9. A pneumatic tyre constructed and arranged substantially as described herein and shown in the accompanying drawing.

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COMPLETE SPECIFICATION

This drawing is a reproduction of the Original on a reduced scale.